Big Hole River

Upper Basin Water Management
2004 Irrigation Season

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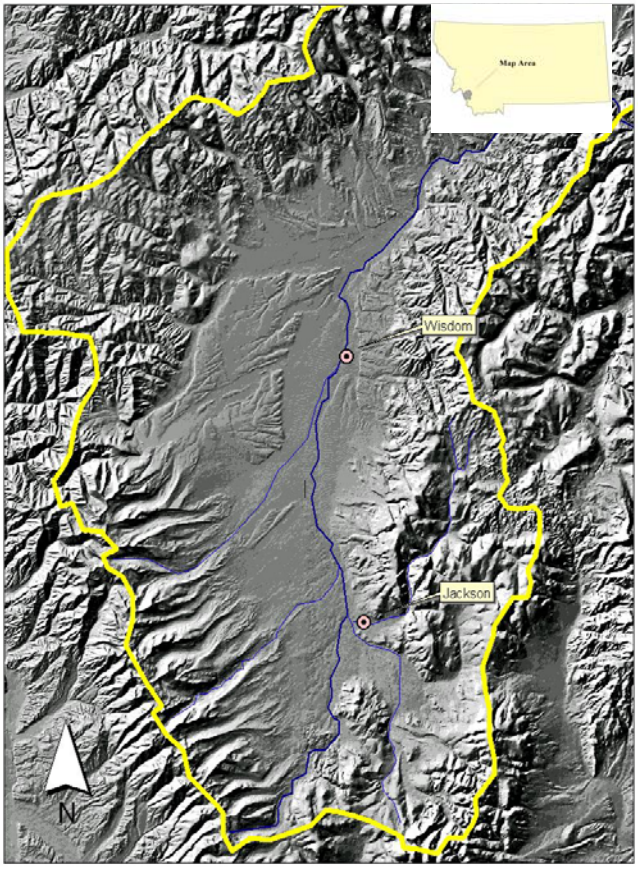
Introduction

The sustainability of agriculture, recreation, and fisheries is a critical concern of water users and stakeholders in the upper Big Hole River. Water availability is the key component to maintaining that sustainability. The upper Big Hole River basin is one of the largest hay and cattle producing areas in Montana (Figure 1). It is also home to the fluvial Arctic Grayling, a candidate species for listing under the Endangered Species Act. In the spring of 2004, low snow pack conditions, cumulative soil moisture deficits, and above average temperatures in March, threatened to continue drought conditions for a sixth consecutive year. When streamflows in the Big Hole River near Wisdom fell below 10 cfs in early May, irrigators, the Big Hole Watershed Committee, and state and federal agencies met to discuss approaches for dealing with impending drought and a potential emergency listing of the grayling.

This report will summarize the water saving efforts put forth by irrigators, state and federal agencies, and the Big Hole Watershed Committee in 2004.

Figure 1. Map of Upper Big Hole River Basin.

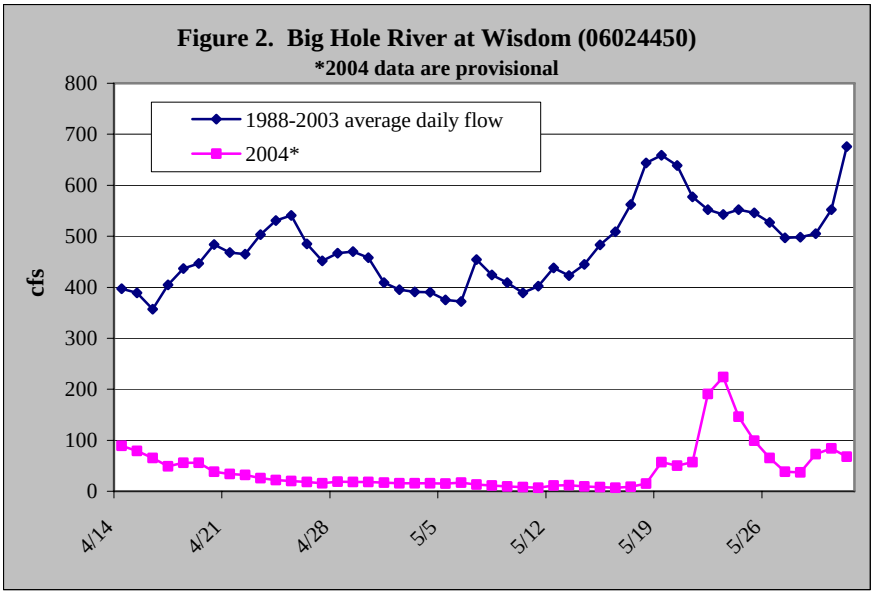


Background

During the winter of 2004, snowpack in the Big Hole basin accumulated at a slightly below normal pace through February. By March, unseasonably warm weather melted the low to mid-elevation snow in the upper basin facilitating some early runoff. Concerns for the impending drought caused ranchers to begin irrigating in early to mid April, as much as two to three weeks earlier than normal for some operations. By early May, flows in the Big Hole River at Wisdom were less than 10 cfs at a time when flows are typically between 300 and 600 cfs (Figure 2.). By the end of the third week of June the remainder of the high elevation snow had melted.

Dramatically low streamflow conditions at the Wisdom gage in May and the threat of emergency endangered species listing of the fluvial Arctic Grayling prompted a series of public meetings amongst water users and stakeholders in the upper basin. The purpose of the public meetings was to inform the water users on the status of water availability, status of the potential emergency listing of the grayling, and to attempt to develop a plan to address impending low flow conditions. The Natural Resource Conservation Service

(NRCS) offered to provide financial assistance to irrigators who were willing to participate in an emergency plan that would pay them to not irrigate certain parcels of land within the affected area. The NRCS also offered to fund ground water extraction for stock tanks in lieu of diverting river and tributary water used solely for livestock. In addition, fencing for managing riparian exclosures and/or riparian pastures was offered to interested ranchers.



EQIP Plan

Using funds appropriated through the Environmental Quality Incentive Program (EQIP), the NRCS accepted applications from interested parties between June 7th and the 16th. Conservation plans were written for 16 water users and included the following:

- 14,491 acres of deferred irrigation.
- 12 stock watering facilities.

(note: no fencing was contracted)

Approximately half of the nearly 15,000 acres of deferred irrigation was for grass hay production, which typically ends its season in early July. The other half was for pasture grass irrigation, which normally diverts water all summer. A total of 49 headgates were either fully or partially shut down when the project was implemented (Figure 3). A three-phase approach was employed with headgates either completely or partially closed on June 21, June 28, or July 5.

Five priority areas were delineated for landowner participation. These areas, listed below, were designed to prioritize and target those areas that would provide the most benefit to streamflows and fisheries in the upper river.

Priority 1 - Mainstem Big Hole River between Big Swamp Creek and Wisdom Bridge
Priority 2 - Tributaries of the Mainstem between Big Swamp Creek and Wisdom Bridge
Priority 3 - Mainstem Big Hole River above Big Swamp Creek Road
Priority 4 - Tributaries to the mainstem above Big Swamp Creek Road

Priority 5 - The following tributaries below Wisdom Bridge: Fishtrap Creek, LaMarche Creek, Deep Creek, Swamp Creek, and Steel Creek.

In addition to the irrigators enrolled in the plan, several public and private entities participated in the efforts to implement the EQIP emergency action plan.

- NRCS
- United States Fish & Wildlife Service
- Montana Department Fish, Wildlife, and Parks
- Montana Department Natural Resources and Conservation
- Montana Chapter of Trout Unlimited
- Big Hole Watershed Committee
- Big Hole River Foundation

The goal of the emergency plan was to provide ranchers compensation for deferring irrigation to specific parcels of land and therefore potentially increasing flows in the Big Hole River. Increasing flows in the Big Hole River, it was anticipated, would improve conditions for the grayling and potentially decrease the likelihood off an emergency listing.

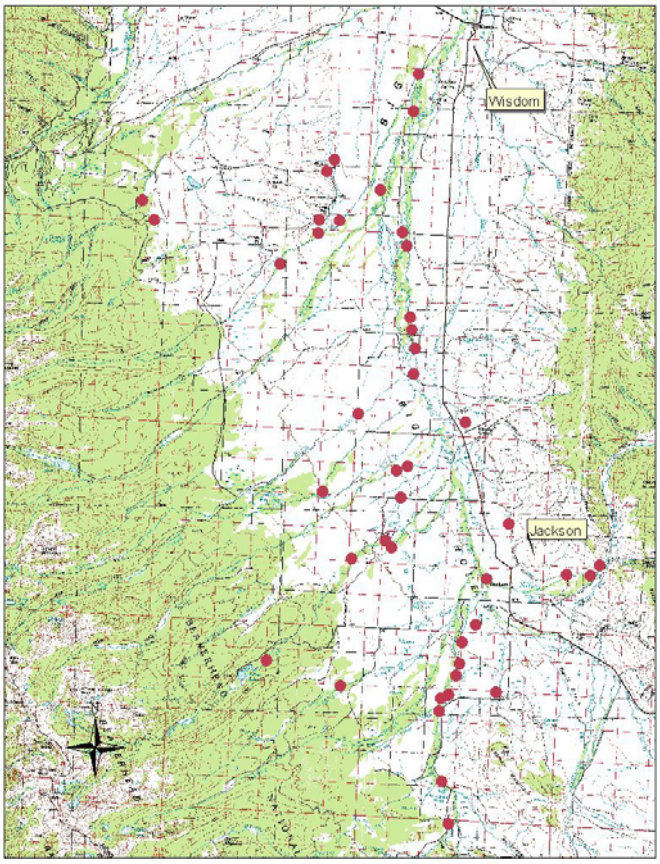


Figure 3. Distribution of headgates affected by EQIP Plan.

In addition to the 16 participants in the NRCS plan, several landowners voluntarily participated in the program (i.e. without financial compensation) either by giving up water similar to those enrolled in the plan or by allowing "conserved" water to bypass their headgates.

Implementation and Monitoring

To ensure the NRCS-EQIP emergency plan was properly implemented, an inter-agency team of hydrologists and biologists were assigned to carryout the conservation plans as prescribed for each participant by the NRCS. In addition, a ditch rider contracted by the Big Hole River Foundation with funding provided by the Montana Chapter of Trout Unlimited, assisted with daily monitoring of streamflows and conservation plans. To implement the plan, flows were reduced or completely shut off at all enrolled points of

diversion. At most of the diversions, a team member was present to assist the landowner with the reduction, as well as to quantify ditch flows to be left in the designated stream. In a few cases, landowners shut off their diversions without the accompaniment of a team member, and therefore quantification of ditch flows were either estimated or relayed through water measurement device readings by the landowner.

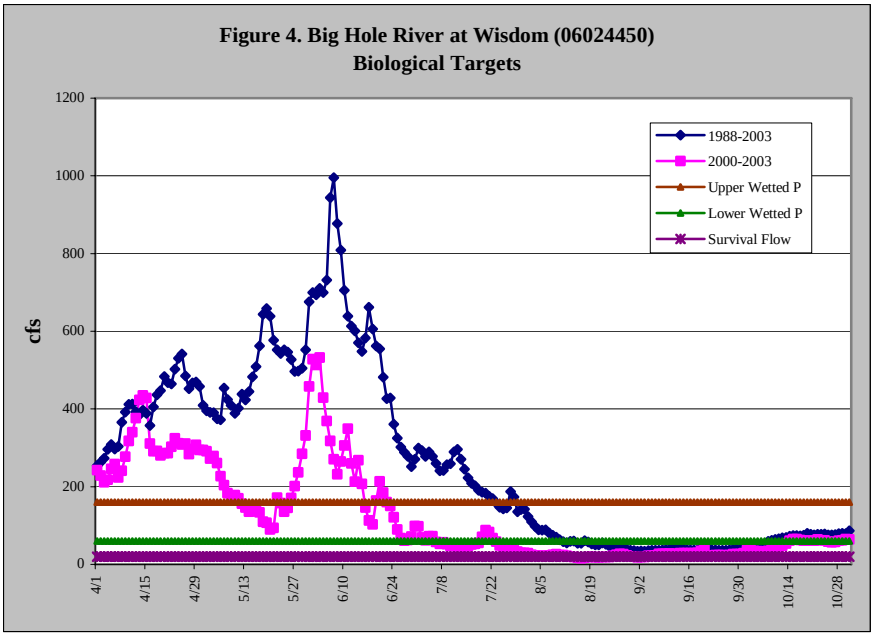
Real-time monitoring of river status was provided by the United States Geological Survey (USGS) Wisdom streamflow gage. This gage represents the key monitoring point for assessing flow conditions in the upper basin. The gage is also located in the most dewatered reach in the upper river. The period of record at this gage site is 17 years. Flow volume for 13 of the last 17 years were less than normal when compared to the long-term gage downstream at Melrose.

River flow levels at the Wisdom gage are monitored for biological needs and for drought plan implementation by FWP and the Big Hole Watershed Committee (Table 1).

Table 1. Flow goals for Big Hole River at Wisdom.

Flow Level (cfs)	Description	Method
160	upper inflection point	FWP Wetted Perimeter Method
60	lower inflection point, initiation of drought plan	FWP Wetted Perimeter Method
40	voluntary closures begin	Big Hole Watershed Committee Drought Plan
20	river closed to fishing	Big Hole Watershed Committee Drought Plan

Mid-July thru September flows at the Wisdom gage typically fall below the flow level criteria listed above and in recent years have averaged at or less than 20 cfs in August and September (Figure 4). While the goal of the emergency plan was to increase river flows as much as possible, a secondary target was to keep flows above the minimum survival



flows of 20 cfs. In addition to the Wisdom streamflow gage, DNRC had seven established continuous streamflow stations located in the upper basin. Three of those sites provide hourly and daily flows in the reach above Wisdom.

For additional tracking of flows associated with this project, a network of staff gages were installed and rated at strategic locations along the river above (Figure 5).

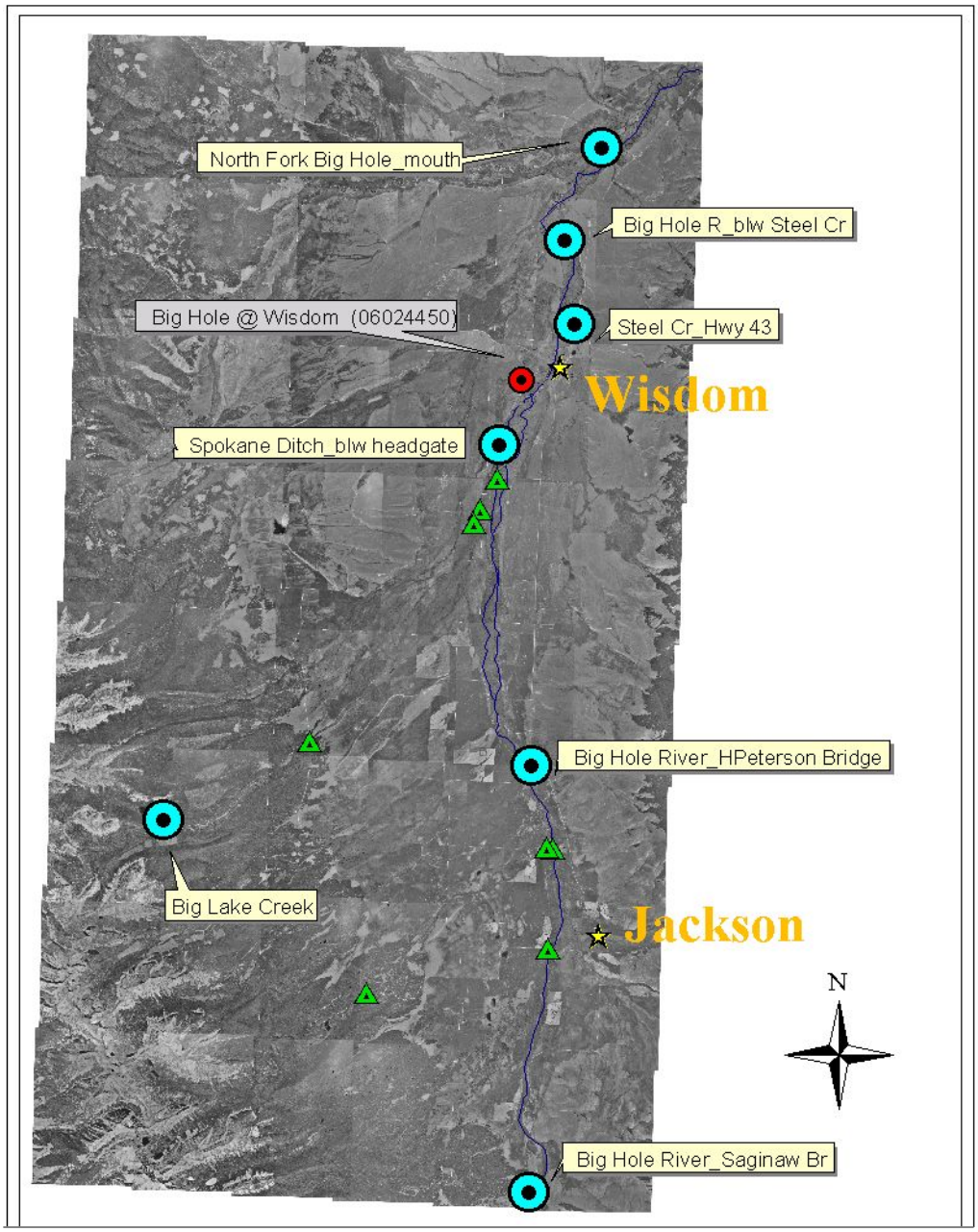


Figure 5. Gaging locations.

Concurrent with and following the flow reductions implemented to comply with all the EQIP contracts, monitoring of tributary and river flows was conducted to attempt to quantify contributions from this project. As well, periodic inspections of site operations

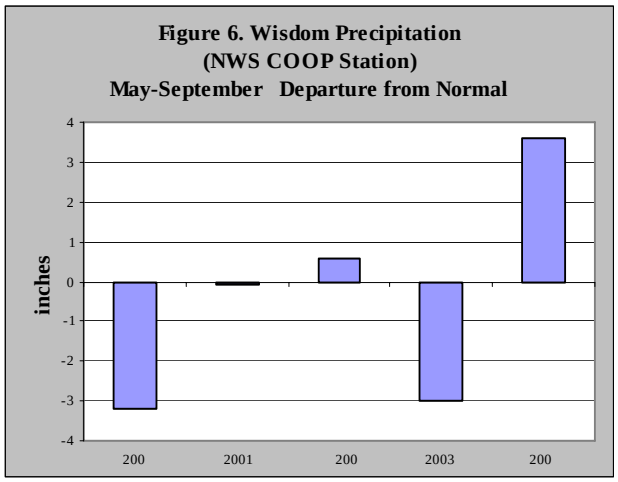
were made to ensure compliance with each individuals EQIP contract and to address concerns voiced by some irrigators in the upper basin.

Results of EQIP Plan

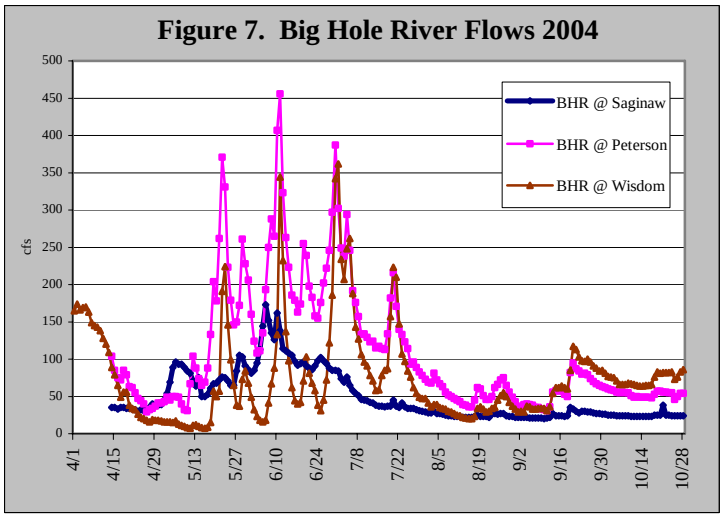
An assessment of streamflow gains due to the implementation of the EQIP emergency plan was based on tracking flows at the various locations in the watershed including the Wisdom gage. Precipitation played a major water contribution role to the project area during the summer months of 2004. While the above normal amount of precipitation contributed positively to streamflows and hay and grass production, it did confound efforts to quantify direct contributions resulting from the EQIP emergency plan.

Precipitation

Normal annual valley precipitation for the upper Big Hole at Wisdom and Jackson is approximately 12 inches with 6.75 of those inches falling between May and September. During the summer of 2004, 10.3 inches of rain fell at Wisdom, nearly four inches above normal (Figure 6). The bulk of the precipitation began mid-June just prior to commencement of the NRCS plan.



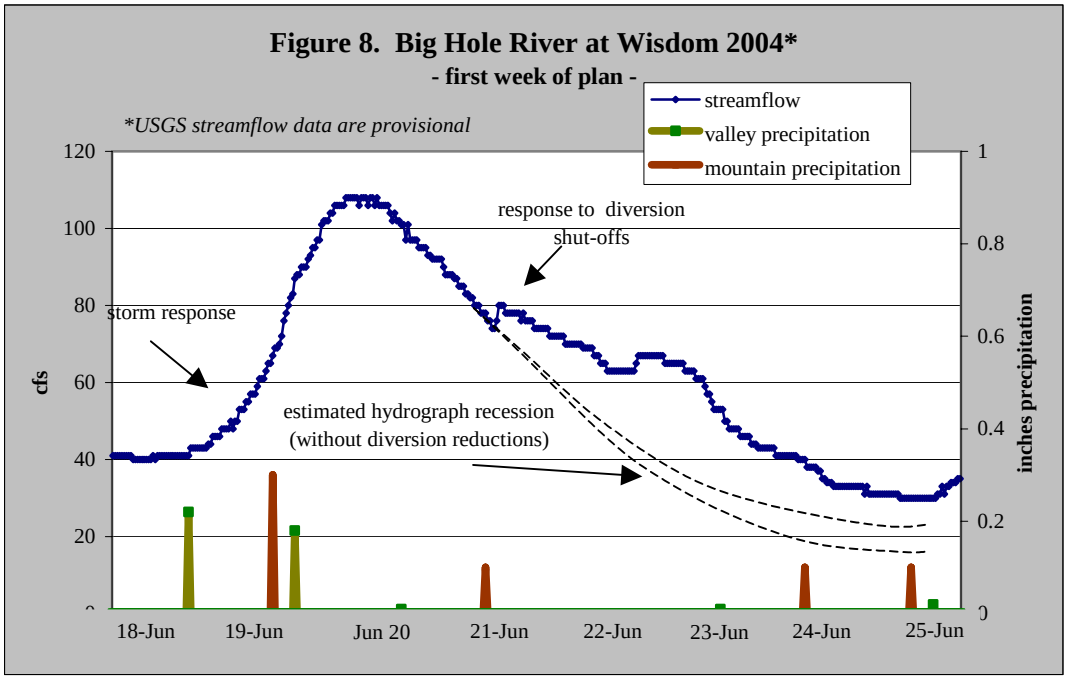
When fields, saturated from flood irrigation receive rain, the response in streamflows is relatively quick due to surface runoff directly into streams. This hydrologic response, observed at the USGS and DNRC continuous streamflow stations, is considered flashy under these circumstances. The response observed at the Big Hole River @ Saginaw station, which is above most irrigation, is much more subtle than the other two stations (Figure 7). A more detailed assessment of precipitation effects on streamflow would require intensive basin modeling and is beyond the scope of this effort.



Increased Flows

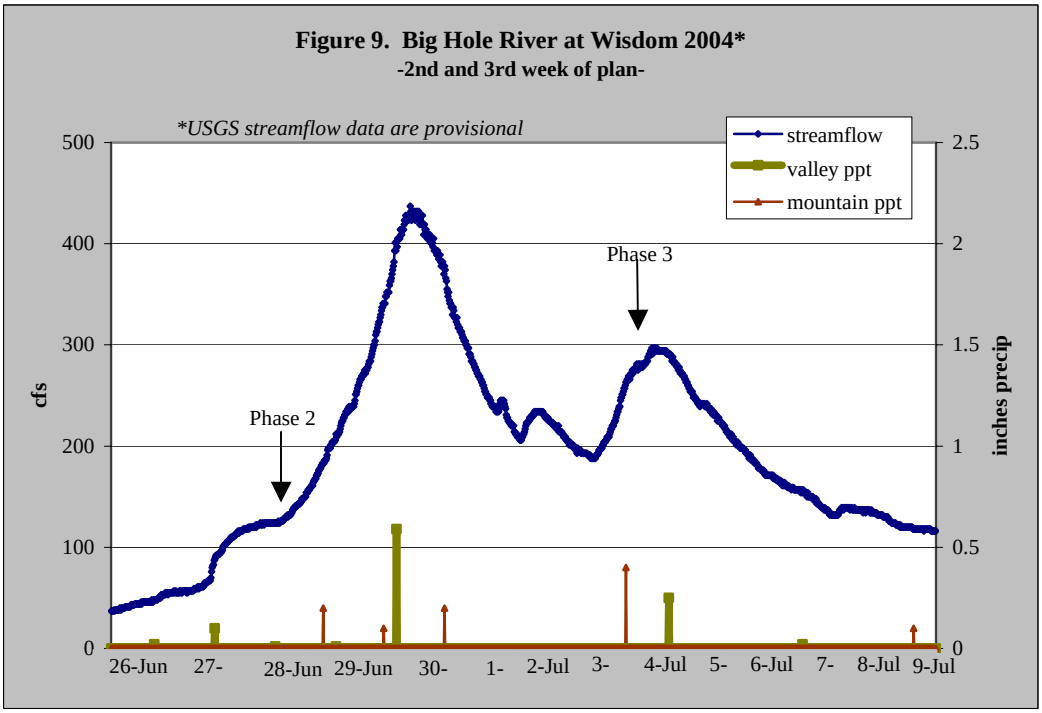
More than 300 cfs was allowed to bypass headgates in the tributaries and mainstem of the Big Hole River over the course of the three phases of implementation. That value is equal to the accumulation of all measured water on the day of each phase implementation. Between the initial adjustment to headgates on June 21 and June 27, the remainder of the high elevation snowpack melted (8.4 inches SWE). In addition, mountain and valley precipitation was occurring throughout the implementation of the project and therefore measured values are only instantaneously accurate. In other words, subsequent readings may have been significantly reduced or in some cases elevated over those at the time of shut down due to naturally declining or rising streamflows. In some cases, especially on tributary streams, headgates that can be regulated do not exist and therefore diversion amounts have historically been a function of water availability. As well, it is highly likely that some water allowed to bypass headgates was picked up by other diversions downstream.

During the summer of 2004, timely precipitation was occasionally responsible for keeping instream river flows above 20 cfs at the Wisdom Bridge. The hydrologic response to summer precipitation was likely much greater than in recent years due to closed headgates deferring storm related flows in-channel. Water normally captured by diversions, was now allowed to bypass and remain instream. Following a storm response in late June, flows at Wisdom were rapidly declining. It is likely that without Phase 1 reductions, flows would have dropped below 20 cfs. Figure 8. shows the hydrologic response to the initial phase of the plan. An unnatural attenuation of recession flows was observed on June 21 and for several days following. In this case, the attenuation was a

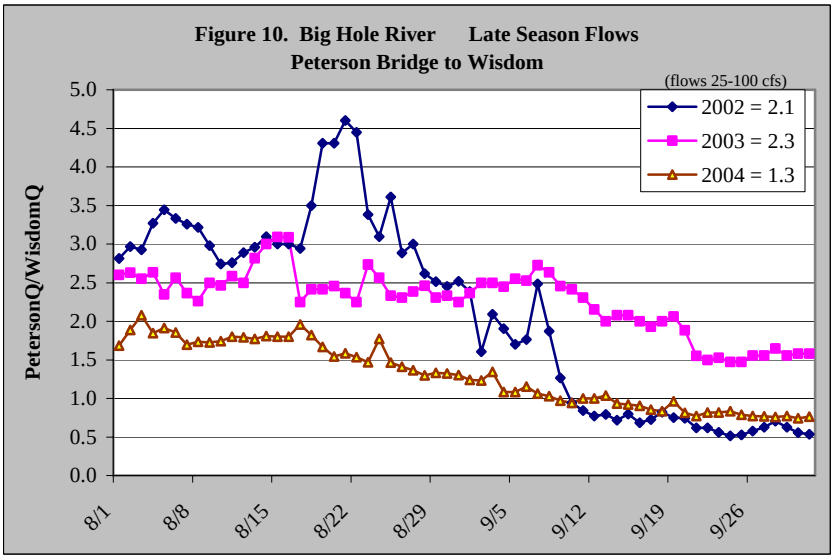


direct result of the cessation of diversion as implemented by the plan and not a function of precipitation. Some mountain precipitation did occur on June 21, however lag time

precludes that event from impacting the initial attenuation of the hydrograph. The hydrologic effects of the implementation of Phases 2 and 3 are much less obvious. With the remainder of snowmelt occurring the week prior to Phase 2 and accompanying mountain and valley precipitation, it is difficult to precisely quantify streamflow contributions of the second two phases of the plan. However, significant increases in flow do coincide with the commencement of each phase. The dramatic positive response observed in the hydrograph is a function of snowmelt, precipitation and closed headgates (Figure 9).



Following hay irrigation and snowmelt, river flows generally declined throughout the summer. Precipitation inputs continued to contribute to streamflows. A change in the relationship between river flows at Peterson Bridge and at Wisdom was observed. In 2002 and 2003, flows at Peterson Bridge were approximately twice flows at Wisdom during this period. During 2004, flows at Peterson Bridge



were 1.3 times flows at Wisdom (Figure 10). This is an indication that a higher percentage of streamflow remained in the river in 2004 and that is likely due to reductions at headgates, greater tributary inputs, and precipitation. A similar relationship was observed between river flows at Saginaw Bridge (above irrigation) and river flows at Peterson Bridge.

On several occasions, daily average flows at Wisdom approached 20 cfs but never fell below that threshold. During the last six years of drought, 2004 is the only year where daily flows never averaged below 20 cfs between July 1 and Oct 1 (Table 2). Observations of snowpack conditions and summer precipitation indicate this was largely a function of summer precipitation and most likely closed headgates that did not capture flows associated with storm events.

Number of days <20 cfs at Wisdom Gage

year	number of days (July 1 - Oct 1)	1-Apr SWE (%)	Precip May-Sept
1999	5	110	4.3
2000	51	86	3.5
2001	59	61	6.6
2002	6	82	7.2
2003	45	106	3.7
2004	0	74	10.3

Table 2. Flow days below 20 cfs at Big Hole River at the Wisdom streamflow gage.

Evaluation and Observations

Based on the data presented in this report, it is evident that the implementation of the NRCS-EQIP emergency plan had an effect on streamflows during the 2004 irrigation season. It is also clear that precipitation played a major role in maintaining those streamflows. Other observations include:

- No emergency listing of the Arctic Grayling.
- Phase 1-diversion reductions kept river flows above 20 cfs at Wisdom during first week of plan.
- Average daily flows at Wisdom never fell below 20 cfs between July 1 and Oct 1.
- By shutting headgates, precipitation-increased flows were allowed to stay in river (i.e. hydrologic response from storms were much greater under EQIP plan conditions).
- Proposed stock watering facilities address long-term solutions to late season diversion.
- Some conservation efforts were conducted voluntarily by landowners in the upper basin (i.e. some landowners gave water up without compensation).
- Increased instream flows were realized in other sections of the watershed besides the Big Hole River at Wisdom.
- Not all water left instream at headgates made it to Wisdom. In many cases, “saved” water was captured by another diversion downstream.
- Precise quantification of plan-contributed flows at Wisdom was difficult due to precipitation inputs and massive number of diversions in upper basin.
- Monitoring indicated that some participants were not in compliance with their contracts and adjustments to compensation were subsequently made.

The development of this plan was clearly designed to provide mostly short-term benefits to streamflow while compensating those irrigators who participated by shutting down streamflow diversions. Long-term benefits include local public awareness of critical low flow conditions that periodically occur in the upper basin, greater knowledge of irrigation and streamflow interactions, and development of agency/landowner relationships that may be key for further management of water resources in the upper Big Hole River basin.